REMARKS

Claims 1-11 and 13 to 18 are all the claims pending in the application, prior to the present Amendment.

Claims 1-6, 8 and 9 have been rejected under 35 U.S.C. §102(b) as anticipated by the newly cited U.S. Patent 4,816,289 to Komatsu et al.

In addition, claims 7, 10, 11 and 13 to 18 have been rejected under 35 U.S.C. §102(b) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over the newly cited U.S. Patent 4,816,289 to Komatsu et al.

Applicants submit that Komatsu et al do not disclose or render obvious the subject matter of the present invention and, accordingly, request withdrawal of these rejections.

The present invention as set forth in claim 1 is directed to a crimped carbon fiber having a multilayer structure comprising an inner layer part and an outer layer part with a hollow structure in the inside thereof, the inner layer part having a carbon structure containing a herringbone structure, the outer layer part having a carbon structure differing from the carbon structure of the inner layer part.

The present invention as set forth in claim 2 is directed to a crimped carbon fiber having a multilayer structure comprising a center part and an outer layer part outside the center part with no hollow structure inside thereof, the center part having a carbon structure containing a shape that carbon layers vertical to the carbon fiber axis are stacked, the outer layer part having a carbon structure differing from the carbon structure of the center part.

Applicants have canceled method claims 11 and 13 to 18.

The above characteristic carbon structure of the present invention, that is, an inner layer part having a carbon structure containing a herringbone structure in claim 1, or a center part having a carbon structure containing a shape that carbon layers vertical to the carbon fiber axis are stacked in claim 2, is not disclosed or suggested in Komatsu et al at all.

Komatsu et al disclose that the carbon layers are arranged substantially in parallel with the longitudinal axis of the filament, and are arranged substantially in the form of growth rings as viewed in cross-section of the filament. See col. 3, lines 49-56.

The direction of the carbon structure is essentially different between that of the present invention, in which there is a herringbone structure or in which the carbon layers are vertical to the carbon fiber axis, and that of Komatsu et al, in which the carbon layers are arranged substantially in parallel with the longitudinal axis of the filament.

Fig. 16 of Komatsu et al is an election micrograph showing a broken portion of a carbon filament of the Komatsu et al invention. However, it is difficult to distinguish the inner layer part and the outer layer part in Fig. 16 of Komatsu et al.

It appears from Figs. 11 and 12 of Komatsu et al that the carbon layers are arranged in parallel with the longitudinal axis of the filament, and not in a herringbone structure of claim 1 of the present application, and not in the form of carbon layers vertical to the carbon fiber axis according to claim 2 of the present application.

Thus, the structure and the manufacturing process are essentially different between the present invention and Komatsu et al.

Therefore, Komatsu et al never disclose or suggest the subject matter of the present invention.

In a section entitled "Response to Arguments," beginning at page 5 of the Office Action, the Examiner responds to the various arguments that applicants submitted as follows:

> Applicants argue that the characteristic carbon structure of the present invention in claims 1 and 2 is not disclosed or suggested in Komatsu et al, further arguing that Komatsu et al disclose that the carbon layers are arranged substantially in parallel with the longitudinal axis of the filament, and are arranged substantially in the form of growth rings as viewed in cross-section of the filament, and that the direction of the carbon structure is essentially different between that of the present invention, in which there is a herringbone structure or in which the carbon layers are vertical to the carbon fiber axis, and that of Komatsu et al, in which the carbon layers are arranged substantially in parallel with the longitudinal axis of the filament.
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> In this regard, Komastu teaches that his filaments have a carbon structure in which planar hexagonal layers are stacked upon heating. Note for example, column 5, lines 25-30. It is the examiner's position that VGCF fibers are grown concentrically or in the axial direction and upon routine processing conditions, such as heating, the hexagonal layers are stacked, forming a herringbone shaped structure, and also tilted with respect to the fiber axis. Therefore, the skilled artisan would have immediately envisaged a herringbone shaped structure or carbon layers vertical to the fiber axis based upon the teachings of Komastu that his planar hexagonal layers are stacked upon heating. Hence, the examiner has reason to believe that the teachings of Komastu anticipate the carbon fibers of present claims 1 and 2. (Emphasis added).

With respect to the Examiner's arguments that Komastu teaches that his filaments have a carbon structure in which planar hexagonal layers are stacked upon heating, that the VGCF fibers of Komatsu are grown concentrically or in the axial direction and upon routine processing conditions, such as heating, the hexagonal layers are stacked, forming a herringbone shaped

structure, and also tilted with respect to the fiber axis, applicants point out that the Examiner does not provide any evidence or reasoning in support of his position that upon routine processing the hexagonal layers would form a herringbone shape. The Examiner's position appears to be based on mere speculation.

Further, the Examiner has not responded to applicants argument that Figs. 11 and 12 of Komatsu show that the carbon layers are arranged in parallel with the longitudinal axis of the filament, and not in a herringbone structure of claim 1 of the present application, and not in the form of carbon layers vertical to the carbon fiber axis according to claim 2 of the present application. Applicants maintain this argument.

Still further, the above Examiner's view is technically not correct.

Komatsu et al teach at column 5, lines 25 to 31 that heating at 2400°C in an Ar gas atmosphere provides graphitization of carbon layers, and do not teach stacking of hexagonal layers in the form of a herringbone structure or in the form of carbon layers vertical to the carbon fiber axis, as can be seen from the following reproduction of Komatsu et al:

> In one aspect of the present invention, there is provided a carbon filament comprising layers and having a carbon structure in which the carbon layers are arranged substantially in parallel with the longitudinal axis of the filament and arranged substantially in the form of growth rings as viewed in cross-section of the filament, the carbon structure exhibiting peaks at 1580 cm^{-1} and ate 1360 cm^{-1} in the Raman scattering spectrum, the ratio (I_{1580}/I_{1360}) of the height of the peak at 1580 cm^{-1} to that at 1360 cm^{-1} being 1 or more,
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> the carbon structure being convertible, upon heating in a argon gas atmosphere at 2400°C for 20 minutes, to a graphite structure in which planar hexagonal carbon network layers (002) are stacked at interlayer spacings (d_{002}) of 0.345 nm or less as measured according to powder X-ray diffractometry and which has a crystalline size (Lc) of 15 nm or more.

Thus, Komatsu et al disclose that the carbon layers are arranged substantially in parallel with the longitudinal axis of the filament and arranged substantially in the form of growth rings as viewed in cross-section of the filament. Further, Komatsu et al disclose at column 9, lines 5 to 12, that the growth rings include the structure of the planar hexagonal carbon network layers.

In addition, since the direction of growth of carbon layers does not change even in a graphitization process, the Examiner's view that "upon heating, the hexagonal layers area stacked, forming a herringbone shaped structure, and also tilted with respect the fiber axis" is not correct.

In this respect, applicants enclose copies of Affidavits of Dr. Howard Tennent and Dr. Gene Dresselhaus which were submitted to the Japanese Patent Office. Dr. Dresselhaus states as follows in the underlined portion at paragraph 11, pages 2 and 3, of his Affidavit:

> The ability of annealing or graphitization processes to change the arrangement of carbon atoms in a fiber is limited by thermodynamic considerations. Annealing or graphitization is effective to correct lattice defects in graphene layers or to align slightly misoriented domains adjacent to one another. As a general proposition major structural rearrangements are not possible. For example, fibers having a fishbone orientation cannot be converted to those having layers parallel to the axis of the fiber because too much energy is required to break and remake all of the bonds.

The Affidavit of Dr. Tennent contains similar statements in the underlined portions of his Affidavit. See paragraphs 15, 16 and 18 of his Affidavit. Thus, annealing at high temperature does not convert the carbon structure. This is the common knowledge to one of ordinary skill in the art.

Thus, the evidence shows that the Examiner's conclusion is not correct that a herringbone shaped structure or carbon layers vertical to the fiber axis would be formed in Komatsu et al.

In view of the above, applicants submit that Komatsu et al do not disclose or render obvious the subject matter of the present invention and, accordingly, request withdrawal of these rejections.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,

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